The Sidereal Messenger.

CONDUCTED BY WM. W. PAYNE,

Director of Carleton College Observatory.

JULY, 1885.

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"He telleth the number of the stars: He calleth them all by their names."

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The Sidereal Messenger

CONDUCTED BY WM. W. PAYNE,

Director of Carleton College Observatory, Northfield, Minnesota.

"In the present small treatise I set forth some matters of interest to all observers of natural phenomena to look at and consider."—GALILEO, *Sidereus Nuncius*, 1610.

VOL. 4. NO. 5. JULY, 1885. WHOLE NO. 35.

The Change of Latitude in the Observations Made at Willet's Point, New York, by ALICE MAXWELL LAMB, *student in the Washburn Observatory.*

In the SIDEREAL MESSENGER for May, 1885, page 117, the results of observations for the latitude of Willet's Point, N. Y. are given, extracted from the printed orders of the Post.

The results for the various years are —

Transferred from old observatory.....Lat. 40° 47′ 21″.70
In 1880 (326 observations on 84 pairs).....Lat. 40° 47′ 21.″59
In 1881 (591 observations on 104 pairs)...Lat. 40° 47′ 21.″47
In 1882 (235 observations on 60 pairs)....Lat. 40° 47′ 21.″37
In 1883 (497 observations on 118 pairs)....Lat. 40° 47′ 21.″15
In 1884 (523 observations on 89 pairs).....Lat. 40° 47′ 20.″75

On these striking results General ABBOT remarks:

"The grand mean of 2,172 observations made at the new observatory during the past five years is: Latitude 40° 47′ 21.″23; but it will be noticed that there has been a steady reduction in the yearly means during this entire period, and that the less exact determination at the old observatory indicates a change in

the same direction. Although the nature of the observations and the small absolute value of the quantity in question, render it quite possible to attribute this solely to errors of observation, the fact is nevertheless suggestive, in view of the favorable report of Messrs. VILLARCEAN, VON BAKHUYZEN, CUTTS, SCHIAPARELLI and CHRISTIE, upon the proposition of Professor FERGOLA (October 16, 1883) to investigate a possible movement of the axis of the earth in its interior, which would cause such a change in latitudes. This report was presented to the International Geodesic Association at its seventh general conference, held at Rome, in October, 1883; and one of the stations proposed for testing the matter was New York City."

At the suggestion of Professor HOLDEN, I have extracted the separate results from the various annual printed results, which were kindly furnished by General ABBOT and arranged them as follows: In the first place all observations with the "Russian Transit" were rejected as this instrument gives poorer results than the Wurdemann and Lingke zenith telescopes. General ABBOT says of it in the printed orders. "The instrument is not so well adapted to reversals and has other defects as a zenith telescope;" and "its precision falls decidedly below that of the Wurdemann pattern."

Secondly, I have retained only those pairs of stars combined thus AA and AA, AA and A, AA and B, A and A or A and B. (The nomenclature is Safford's, and the places are without exception from his last catalogue and therefore good.)

Thirdly, I have rejected the observations of T. A. B. in 1880 and of G. D. F. in 1884, on the evidence of the observations themselves. Their probable errors are in each case about twice as large as those retained.

Fourthly, I have arranged the observations of all well determined pairs taken with the Wurdermann instrument, *by pairs*, and by years. Table I gives the results and 1884 is the only year which stands out from the general mean.

Rejecting 1884, the observations of the years 1880, 1881

1882, 1883 are in fair agreement. In 1884 the results 17.″75 is probably the result of some large error, very possibly an error of 10″ in the reduction, and the last result 20″ depends only upon one observation.

Fifthly, I have arranged all the observations of well determined pairs made with the Lingke Instrument, which was only used in 1881, 1883 and 1884 in Table II. Here I have not given the separate pairs to avoid complicating the table, but the meaning of the horizontal lines is clear.

The various mean results are in good agreement.

Sixthly, I have given in Table III the separate results of all observations of well determined stars with *both* the good iustruments arranged by years and observers, including however only those observers who have worked in two consecutive years. This restriction excludes *all* of the discordant results of the Wurdemann instrument, 1884, and it is a fact worthy of remark that all the observers with this instrument in 1884 were observing for their first year. The results of this table are in fair agreement except perhaps that of 1883.

It would seem that the method of grouping employed in each table is a fair one. If the observations used in each table had been the only ones made, it is tolerably certain that the discordances would have been attributed simply to large accidental errors, which certainly exist. Taking all three tables together there is perhaps strong reason to attribute the systematic change of latitude to such errors alone, as General ABBOT himself suggests.

It would seem to be desirable to observe the same pairs with both instruments and to have each observer work in two (or more) consecutive years with the same instrument. And if the Russian Transit could be used in the prime-vertical a valuable check would be afforded.

WASHBURN OBSERVATORY,
UNIVERSITY OF WISCONSIN, MADISON.

TABLE I.

Summary of all the observations of well determined stars, with the Wurdemann instrument, by all observers (excluding T. A. B., 1880) in the years 1880, '81, '82, '83, '84.

WURDEMANN INSTRUMENT.

Star pair	1880	1881	1882	1883	1884
1313 A / 1335 B	21.27 (4)	21.76 (6)	22.60 (5)	22.38 (6)	19.81 [6]
1342 A / 1351 B	20.76 [5]	22.26 [7]	20.70 [7]	20.47 [8]	20.31 [6]
1397 A A / 1406 A	22.09 [1]	20.51 [2]	21.94 [6]	20.62 [7]	20.59 [5]
1416 B / 1431 A	22.85 [2]	21.64 [2]	21.56 [2]	22.29 [8]	17.75 [4]
1493 A / 1499 A	21.25 [2]	21.57 [3]	21.66 [8]	21.16 [5]	20.00 [1]
Mean by weights	21″.37 [14]	21″.77 [20]	21.″64 [28]	21″.37 [34]	19″.76[22]
Grand mean by wts. of all the above results= 21″.29					
Residuals	+0″.08	+0″.48	+0″.35	+0″.08	−1″.53
Grand mean by wts. rejecting 1884=.....21″.53					
Residuals	−0.16	+0.24	+0.11	−0.16	.....

TABLE II.

Summary of all the observations of well determined stars with the Lingke instrument, by all observers (excluding G. D. F. in 1884) in the years 1881, 1883, 1884.

LINGKE INSTRUMENT.

	1881	1883	1884
Employing same pairs	21″.31 [25]	21″.21 [23]	.....
Employing same pairs	.....	21.33 [48]	20.99 [65]
Employing all pairs	21.31 [25]	21.29 [71]	20.99 [65]
Grand mean (by wts)=.....		21″.17	
Residuals	+0″.14	+0″.12	−0″.18

No pairs common to all three years, 1881, 1883, 1884.

TABLE III.

Summary of all the observations of well determined stars by both the Wurdemann and Lingke Instruments and by all observers who observed in two consecutive years (excluding T. A. B. and G. D. F.) for the years 1880, 1881, 1882, 1883, 1884.

OBSERVERS WITH WURDEMANN AND LINGKE INSTRUMENTS.

Observers	1880	1881	1882	1883	1884
F. V. A.	21″.24 [29]	21″.00 [47]	.....	.....	.....
G. J. F.	21.06 [23]	21.17 [35]	.....	.....	.....
C. McD.T.	21.49 [11]	21.59 [26]	.....	.....	.....
T. L. C.	21.99 [24]	21.36 [34]	.....	.....	.....
J. B	.....	.....	21″.23 [35]	21″.36 [24]	.....
H. F. H.	.....	.....	20.93 [28]	21.44 [31]	.....
J. G. W.	.....	.....	20.87 [21]	20.45 [33]	.....
E. B.	.....	.....	.....	20.87 [31]	19″.72 [6]
O. T. C.	.....	.....	.....	20.90 [28]	20.13 [14]
E. T. S.	.....	.....	.....	18.24 [33]	21.80 [16]
L. H. B.	.....	.....	.....	19.16 [28]	20.86 [23]
Mean by wts.	21.43 (87)	21.23 (142)	21.04 (84)	20.21 (208)	20.79 (61)
Grand mean (by wts)=.....			20.″91		
Residuals	+0″.52	+0 .32	+0 .13	−0 .70	−0 .12

Photometric Measurements at the Harvard College Observatory of the Faintest Stars in the Charts Constructed by PALISA.

These measurements were made at the request of Professor E. S. HOLDEN, Director of the Washburn Observatory, Madison, Wisconsin, for the purpose of furnishing additional information with regard to the distribution of the stars in space. In such inquiries, the results obtained by different telescopes must be compared together, and hence the magnitude of the faintest stars visible in a given telescope must be determined by some other means than estimates made upon an arbitrary scale. The chart employed as the basis of the investigation here described was kindly furnished by Dr. J. PALISA. It represents all stars within its limits visible at Pola with a telescope, the aperture of which was 6 French inches (16.24 cm.), the mag-

nifying power being 56. This chart was compared with the sky by means of the large equatorial telescope at the Harvard College Observatory, and three groups of stars were selected as examples of the faintest objects visible at Pola. This selection was referred to Professor HOLDEN for his approval, after receiving which, the selected stars were compared with Epsilon *Hydræ* by means of the instrument described in Volume XI of the Annals of the Harvard College Observatory under the name of Photometer I. The resulting magnitudes depend upon that of Epsilon *Hydræ* as determined by the meridian photometer. The difference of magnitude determined by Photometer I may hereafter require corrections derived from other investigations now in progress with the same instrument, but these corrections will probably be small.

Table I contains the results of the separate observations. The stars are designated in the first two columns by the number of the group containing them and by letters of the alphabet. The next two columns give approximate right ascensions and declinations, depending only on the chart, and serving to identify the stars. The next column gives the magnitude of each star as estimated, after adjustment of the scale of the estimates to that of the photometer. Two of these estimates placed in brackets are not adjusted. They relate to comparatively bright stars, inserted in the list only as guides in finding the others. The next column gives the number of observations, each observation consisting of three comparisons. The date of the observations were April 16 and 17, 1885. The observer was Professor SEARLE, who had previously selected the groups to be measured. When one observation only occurs it was made on April 17. The stars which were not measured are retained in the list merely to facilitate the identification of the others. The number of observations is followed by the mean result for magnitude. The next column gives the residuals from this mean of the separate observations, when the star was twice observed. Accordingly, in the case of the first star, the two results appear from this column to have been 13.7 and 13.5. The last column indicates the stars not represented on the chart, or not measured.

TABLE I.

Group	Desig.	R. A. 1855	Decl., 1855	Est.	No. Obs.	Result	Resid.	Remarks.
I.	*a*	8h 40m 50s	+7° 30′.7	14.0	2	13.6	0.1, +—0.1	
	b	40 56	31.8	14.0	2	14.1	+0.1,—0.1	
	c	40 58	30.8	13.8	2	13.8	+0.1,—0.2	
	d	40 51	32.8	14.1	2	14.4	0.0, +0.1	
	e	40 59	30.5	14.1	2	14.4	+0.1,—0.2	Not on chart.
	f	40 56	31.3	15.2	1	15.7	.....	Not on chart.
II.	*a*	43 38	25.4	[9.5]	..	....	.....	Not measured.
	b	43 28	26.5	14.0	2	13.7	—0.1, +0.1	
	c	43 32	27.7	13.8	2	13.8	—0.3, +0.2	
	d	43 40	27.5	14.7	2	15.0	—0.2, +0.1	Not on chart.
	e	43 41	27.5	14.7	..	....	.....	Not on chart.
	f	43 52	24.5	14.2	2	14.3	—0.3, +0.3	
	g	44 5	24.5	13.8	2	14.0	0.0, +0.1	
	h	44 10	23.0	14.0	2	13.8	—0.2, +0.3	
	i	43 29	27.0	15.0	1	15.0	.....	Not on chart.
III	*a*	45 18	15.0	[9.5]	..	....	.....	Not measured
	b	45 2	14.0	14.5	2	14.1	0.0, 0.0	
	c	45 12	15.8	14.2	2	14.1	0.0, 0.0	
	d	45 18	18.0	14.0	2	14.0	—0.1, 0.0	
	e	45 12	15.1	14.8	1	14.7	.....	Not on chart.
	f	45 1	15.0	15.0	..	....	.....	Not on chart

Table II gives a summary of the results contained in Table I. The first column contains the number of the group, and the second the number of stars in the group which were represented on the chart and measured with the photometer. The next two columns give the mean results for each group on the two days of observation, and the last column gives the general mean. At the foot of these columns are given the corresponding results for the stars from all three groups taken together.

TABLE II.

		Results for Magnitude.		
Group.	No. of Stars.	April 16.	April 17.	Mean.
I	4	14.0	13.9	14.0
II	5	13.7	14.1	13.9
III	3	14.0	14.1	14.0
All	12	13.9	14.0	14.0

The magnitude of the faintest stars visible with the telescope used at Pola appears, accordingly, to be approximately 14 upon the photometric scale. The accordance of the photometric results indicates a probable error of .14 for a single observation. The average difference between the adjusted estimates and the measurements is .20.

ON THE SOLAR CORONA.*

BY DR. WILLIAM HUGGINS.

If it were usual to prefix a motto to these evening discourses, I might have selected such words as "Seeing the Invisible," for I have to describe a method of investigation by which what is usually unseeable may become revealed. We live at the bottom of a deep ocean of air, and therefore every object outside the earth can be seen by us only as it looks when viewed through this great depth of air. Professor LANGLEY has shown recently that the air mars, colors, distorts, and therefore misleads and cheats us to an extent much greater than was supposed. LANGLEY considers that the light and heat absorbed and scattered by the air and the particles of matter floating in it amount to no less than 40 per cent. of the light falling upon it. In consequence of this want of transparency and of the presence of finely divided matter always more or less suspended in it, the air, when the sun shines upon it, becomes itself a source of light. This illuminated ærial ocean necessarily conceals from from us by overpowering them any sources of light less brilliant than itself which are in the heavens beyond. From this cause the stars are invisible at midday. This illuminated air also conceals from us certain surroundings and appendages of the sun, which become visible on the very rare occasions when the moon coming between us and the sun cuts off the sun's light from the air where the eclipse is total, and so allows the observer to see the surroundings of the sun through the cone of unilluminated air which is in shadow. It is only when the ærial curtain of light is thus withdrawn that we can become spectators of what is taking place on the stage beyond. The magnificent scene never lasts more than a few minutes, for the moon passes and the curtain of light is again before us. On an average, once in two years this curtain of light is lifted for

*A lecture delivered recently before the Royal Institution of Great Britain.

from three to six minutes. I need not say how difficult it is from these glimpses at long intervals even to guess at the plot of the drama which is being played out about the sun.

The purpose of this discourse is to describe a method by which it is possible to overcome the barrier presented to our view by the bright screen of air, and so watch from day to day the changing scenes taking place behind it in the sun's surroundings.

The object of our quest is to be found in the glory of radiant beams and bright streamers intersected by darker rifts which appears about the sun at a total solar eclipse. The corona possesses a structure of great complexity, which is the more puzzling in its intricate arrangement, because though we seem to have a flat surface before us, it exists really in three dimensions. If we were dwellers in Flatland and the corona were a sort of glorified catherine-wheel, the task of interpretation would seem less difficult. But as we are looking at an object having thickness as well as extension, the forms seen in the corona must appear to us more or less modified by the effect of perspective. This consideration tells us also that the intrinsic brightness of the corona towards the sun's limb is much less than its apparent brightness as seen by us, of which no inconsiderable part must be due to the greater extent of corona in the line of sight as the sun is approached. The corona undergoes great and probably continual change, as the same coronal forms are not present at different eclipses.

The attempts which have been made from time to time to see the corona without an eclipse have been based mainly upon the hope that if the eye were protected from the intense direct light of the sun, and from all light other than that from the sky immediately about the sun, then the eye might become sufficently sensitive to perceive the corona. These attempts have failed because it was not possible to place the artificial screen where the moon comes, outside our atmosphere, and so keep in shadow the part of the air through which the observer looks.

The latest attempts have been made by Professor LANGLEY at Mount Whitney, and Dr. COPELAND, assistant to Lord CRAWFORD, on the Andes. Professor LANGLEY says, "I have tried visual methods under the most favorable circumstances, but with entire non-success." Dr. COPELAND observed at Puno, at a height of 12,040 feet. He says: "It ought to be mentioned that the appearances produced by the illuminated atmosphere were often of the most tantalizing description, giving again and again the impression that my efforts were about to be crowned with success."

There are occasions on which the existence of the brighter part of the corona near the sun's limb can be detected without an eclipse. The brightness of the sky near the sun's limb is due to two distinct factors, the air glare and the corona behind it, which M. JANSSEN considers to be brighter than the full moon. When *Venus* comes between us and the sun it is obvious that the planet as it approaches the sun, comes in before the corona, and shuts off the light which is due to it. To the observer the sky at the place where the planet is appears darker than the adjoining parts, that is to say, the withdrawal of the coronal light from behind has made a sensible diminution in the brightness of the sky. It follows that the part of the sky behind which the corona is situated must be brighter in a small degree than the adjoining parts, and it would perhaps not be too much to say that the corona would always be visible when the sky is clear, if our eyes were more sensitive to small differences of illumination of adjacent areas. My friend, Mr. JOHN BRETT, A. R. A., tells me that he is able to see the corona in a telescope of low power.

The spectroscopic method by which the prominences can be seen fails because a part only of the coronal light is resolved by the prism into bright lines, and of these lines no one is sufficiently bright, and co-extensive with the corona, to enable us to see the corona by its light, as the prominences may be seen by the red, the blue, or the green line of hydrogen.

The corona sends to us light of three kinds. (1) Light which the prism resolves into bright lines, which has been emitted by luminous gas. (2) Light which gives a continuous spectrum, which has come from incandescent liquid or solid matter. (3) Reflected sunlight, which M. JANSSEN considers to form the fundamental part of the coronal light.

The problem to be solved was how to disentangle the coronal light from the air-glare mixed up with it, or in other words how to give such an advantage to the coronal light that it might hold its owh sufficiently for our eyes to distinguish the corona from the bright sky.

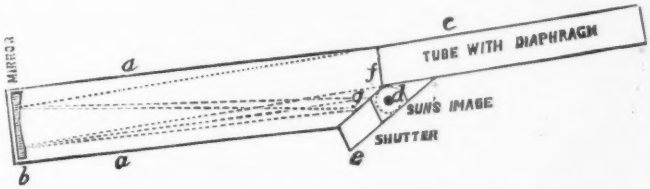
When the report reached the country in the summer of 1882 that photographs of the spectrum of the corona taken during the eclipse in Egypt showed that the coronal light seen from the earth, as a whole is strong in the violet region, it seemed to me probable that if by some method of selective absorption this kind of light were isolated, then when viewed by this kind of light alone the corona might be at a sufficient advantage relatively to the air-glare to become visible. Though this light falls within the range of vision, the eye is less sensitive to small differences of illumination near this limit of its power. This consideration and some others led me to look to photography for aid, for it is possible by certain technical methods to accentuate the extreme sensitiveness of a photographic plate for minute differences of illumination. [A cardboard on which a corona had been painted by so thin a wash of Chinese white that it was invisible to the audience had been photographed. The photograph thrown upon the screen showed the corona plainly.] This cardboard represents the state of things in the sky about the sun. The painted corona is brighter than the cardboard, but our eyes are too dull to see it. In like manner the part of the sky near the sun where there is a background of corona, is brighter than the apjoining parts where there is no corona behind, but not in a degree sufficiently great for our eyes to detect the difference.

A photographic plate possesses another and enormous advantage over the eye, in that it is able to furnish a permanent record of the most complex forms from an instantaneous exposure.

In my earlier experiments the necessary isolation of violet light was obtained by interposing a screen of coloured glass or a cell containing potassic permanganate. The possible coming of false light upon the sensitive plate from the glass sides of the cell, as well as from precipitation due to the decomposition of the potassic permanganate under the sun's light, led me to seek to obtain the necessary light-selection in the film itself. Captain ABNEY had shown that argentic bromide, iodide and chloride, differ greatly in the kind of light to which they are most sensitive. The chloride is most strongly affected by violet light from *h* to a little beyond K. It was found possible by making use of this selective action of argentic chloride to do away with an absorptive medium. To prevent reflected light, the back of the plate was covered with asphaltum varnish, and frequently a small metal disc a little larger than the sun's image was interposed in front of the plate to cut off the sun's direct light.

The next consideration was as to the optical means by which an image of the sun, as free as possible from imperfections of any kind, could be formed upon the plate. For several obvious reasons the use of lenses was given up, and I turned to reflection from a mirror of speculum metal. My first experiments were made with a Newtonian telescope by SHORT. With this instrument, during the summer of 1882, about twenty plates were taken on different days, in all of which coronal forms are to be seen about the sun's image. After a very critical examition of these plates, in which I was greatly helped by the kind assistance of Professor STOKES and Captain ABNEY, there seemed to be good ground to hope that the corona had really been obtained on the plates. [One of these negatives, obtained in August, 1882, was shown upon the screen.]

In the spring of the following year, 1883, the attack upon the corona was carried on with a more suitable apparatus. The Misses LASSELL were kind enough to lend me a seven-foot Newtonian telescope made by Mr. LASSELL, which possesses great perfection of figure and retains still its fine polish. For the purpose of avoiding the disadvantage of a second reflection from the small mirror, and also of reducing the aperture to $3\frac{1}{2}$ inches, which gives a more manageable amount of light, I adopted the arrangement of the instrument which is shown in the following woodcut:



The speculum *b* remains in its place at the end of the tube *a*, *a*, by which the mechanical inconvenience of tilting the speculum within the tube as in the ordinary form of the Herschelian telescope is avoided.

The small plane speculum and the arm carrying it were removed. The open end of the tube is fitted with a mahogany cover. In this cover at one side is a circular hole *f*, $3\frac{1}{4}$ inches in diameter, for the light to enter; below is a similar hole over which is fitted a framework to receive the "backs" containing the photographic plates, and also to receive a frame with fine-ground glass for putting the apparatus into position. Immediately below, towards the speculum, is fixed a shutter with an opening of adjustable width, which can be made to pass across more or less rapidly by the use of indiarubber bands of different degrees of strength. In the front of the opening *f* is fixed a tube *c*, six feet long, fitted with diaphragms, to restrict as far as possible the light which enters the telescope to that which comes from the sun and the sky immediately around

it. The telescope-tube *a*, *a*, is also fitted with diaphragms, which are not shown in the diagram, to keep from the plate all light, except that coming directly from the speculum. It is obvious that, when the sun's light entering the tube at *f* falls upon the central part of the speculum, the image of the sun will be formed in the middle of the second opening at *d*, about two inches from the position it would take if the tube were directed axially to the sun. The exquisite definition of the photographic images of the sun shows, as was to be expected, that this small deviation from the axial direction, two inches in seven feet, does not affect sensibly the performance of the mirror. The whole apparatus is firmly strapped on to the refractor of the equatorial in my observatory, and carried with it by the clock motion.

The performance of the apparatus is very satisfactory. The photographs show the sun's image sharply defined; even small spots are seen. When the sky is free from clouds, but presents a whity appearance from the large amount of scattered light, the sun's image is well defined upon a uniform background of illuminated sky, without any sudden increase of illumination immediately about it. It is only when the sky becomes clear and blue in color that coronal appearances present themselves with more or less distinctness. [Several negatives taken during the summer of 1883 were shown on the screen.] In our climate the increased illumination of the sky where there is a background of coronal light is too small to permit the photographs which show this difference to be otherwise than very faint. A small increase of exposure, or of development, causes it to be lost in the strong photographic action of the air-glare. For this reason, the negatives should be examined under carefully arranged illumination. They are not, therefore, well adapted for projection on a screen. [A negative taken with a whity sky, showed a well defined image of the sun, with a sensibly uniform surrounding of air-glare, but without any indication of the corona. In the case of the other negatives exhib-

ited, which were taken on clearer days, an appearance, very coronal in character, was to be seen about the sun.]

On May 6, the corona was photographed during a total eclipse at Caroline Island by Messrs. LAWRENCE and WOODS. This circumstance furnished a good opportunity of subjecting the new method to a crucial test, namely, by making it possible to compare the photographs taken in England where there was no eclipse, with those taken on Caroline Island of the undoubtedly true corona during the eclipse. On the day of the eclipse the weather was bad in this country, but plates were taken before the eclipse, and others later on. These plates were placed in the hands of Mr. WESLEY, who had had great experience in making drawings from the photographs taken during former eclipses. Mr. WESLEY drew from the plates before he had any information of the results obtained at Caroline Island, and he was therefore wholly without bias in the drawings which he had made from them. [Photographs of Mr. WESLEY's drawings were projected on the screen, and then a copy of the Caroline Island eclipse photograph. The general resemblance was unmistakable, but the identity of the object photographed in England and at Caroline Island was placed beyond doubt by a remarkably formed rift on the east of the north pole of the sun. This rift, slightly modified in form, was to be seen in a plate taken about a solar rotation period before the eclipse, and also on a plate taken about the same time after the eclipse. The general permanence of this great rift certainly extended over some months, but no information is given as to whether the corona rotates with the sun. For from the times at which the plates were taken, one about a rotation period before and the other a rotation period after the eclipse, it is obvious the rift might have gone round with the sun, but there is no positive evidence on this point.*]

As the comparison of the English plates with those taken at Caroline Island possesses great interest, I think it well to put on record here a letter written by Mr. LAWRENCE to Professor STOKES, dated September 14, 1883: —

*See Plates XI and XIA, British Association Report, 1883, p. 348.

"Dr. HUGGINS called upon Mr. WOODS this morning and showed us the drawings Mr. WESLEY had made of his coronas. Ae told us that he particularly did not wish to see our negatives, but that he would like to compare his results with ours. We did so, and found that some of the strongly marked details could be made out on his drawings, a rift near the north pole being especially noticeable; this was in a photograph taken on April 3, in which the detail of the northern hemisphere is best shown, while the detail of our southern hemisphere most resembles the photograph taken on June 6; in fact, our negatives seem to hold an intermediate position. Afterwards I went with Dr. HUGGINS and Mr. WOODS to Burlington House to see the negatives. The outline and distribution of light in the inner corona of April 3rd is very similar to that on our plate which had the shortest exposure; the outer corona is, however, I think, hidden by atmospheric glare. As a result of the comparison, I should say that Dr. HUGGIN's coronas are certainly genuine as far as 8′ from the limb."

Though the plates which were obtained during the summer of 1883 appeared to be satifsactory to the extent of showing that there could be little doubt remaining but that the corona had been photographed without an eclipse, and therefore of justifying the hope that a successful method for the continuous investigation of the corona had been placed in the hands of astronomers, yet as the photographs were taken under the specially unfavorable conditions of our climate, they failed to show the details of the structure of the corona.

The next step was obviously to have the method carried out of some place of high elevation, where the larger part of the glare which is due to the lower and denser parts of our atmosphere would no longer be present. I ventured to suggest to the Council of the Royal Society that a grant from the fund placed annually by the Government at the disposal of the Royal Society, should be put in the hands of a small committee for this purpose. This suggestion was well received, and a committee was appointed by the Council of the Royal Society. The committee selected the Riffel near Zermatt in Switzerland, a station which has an elevation of 8500 feet, and the further

advantages of easy access, and of hotel accomodation. The committee was fortunate in securing the services, as photographer, of Mr. RAY WOODS, who as assistant to Professor SCHUSTER had photographed the corona during the eclipse of 1882 in Egypt, and who in 1883, in conjunction with Mr. LAWRENCE, had photographed the eclipse of that year at Caroline Island.

Mr. WOODS arrived at the Riffel in the beginning of July 1884, with an apparatus, similar to the one shown in the woodcut on a former page, constructed by Mr. GRUBB.

Captain ABNEY who had made observations on the Riffel in former years, had remarked on the splendid blue-black skies which were seen there whenever the lower air was free from clouds or fog. But unfortunately during the last year or so a veil of finely divided matter of some sort has been put about the earth, of which we have heard so much in the accounts from all parts of the earth of gorgeous sunsets and afterglows. This fine matter was so persistently present in the higher regions of the atmosphere during last summer, that Mr. WOODS did not get once a really clear sky. On the contrary, whenever visible cloud was absent, then instead of a blue-black sky there came into view a luminous haze, forming a great aureole about the sun, of a faint red color, which passed into bluish white near the sun. Mr WOODS found the diameter of the aureole to measure about 44°. This appearance about the sun has been seen all over the world during last summer, but with greatest distinctness at places of high elevation.

The relative position of the colors, blue inside and red outside, shows that the aureole is a diffraction phenomenon due to minute particles of matter of some kind. Mr. ELLERY, Captain ABNEY, and some others consider the matter to be water in the form probably of minute ice spicules; others consider it to consist of particles of volcanic dust projected into the air during the eruption at Krakatoa; but whatever it is, and whencesoever it came, it is most certainly matter in the wrong place so far as astronomical observations are concerned, and in a peculiar degree for success in photographing the corona. We are only beginning to learn that whether in our persons or in

our works, it is by minimized matter chiefly that we are undone. So injurious was the effect of this aureole that it was not possible to obtain any photographs of the corona at my observatory near London. This great diffraction aureole went far to defeat the object for which Mr. Woods had gone to the Riffel, but fortunately, the great advantage of being free from the effects of the lower 8000 feet of denser air told so strongly, that notwithstanding ever-present aureole Mr. Woods was able to obtain a number of plates on which the corona shows itself with more or less distinctness. [Three untouched photographic copies of the plates taken at the Riffel were shown upon the screen.] From the presence of the aureole the negatives show less detail than we have every reason to believe would have been the case if the sky had been as blue and clear as in some former years. This circumstance makes great care necessary in the discussion of these plates, and it would be premature to say what information is to be obtained from them.

[As an illustration of the differences of form which the corona has assumed at different eclipses, photographs taken in 1871, 1878, 1882, and 1883 were projected on the screen. Attention was called to the equatorial extension seen in a photograph taken in 1878, and to the suggestion which had been put forward that this peculiar character was connected with the then comparative state of inactivity of thesun's surface, at a period of minimum sun-spot action, especially as an equatorial extension was observed in 1867.]

It is now time that something should be said of the probable nature of the corona.

Six hypotheses have been suggested: —

1. That the corona consists of a gaseous atmosphere resting upon the sun's surface and carried around with it.

2. That the corona is made up, wholly or in part, of gaseous and finely divided matter which has been ejected from the sun, and is in motion about the sun from the forces of ejection, of the sun's rotation, and of gravity, — and possibly of repulsion of some kind.

3. That the corona resembles the rings of Saturn, and con-

sists of swarms of meteoric particles revolving with sufficient velocity to prevent their falling into the sun.

4 That the corona is the appearance presented to us by the unceasing falling into the sun of meteoric matter and the debris of comets' tails.

5. That the coronal rays and streamers are, at least in part, meteoric streams strongly illuminated by their near approach to the sun, neither revolving about nor falling into the sun, but permanent in position and varying only in richness of meteoric matter, which are parts of eccentric comet orbits. This view has been supporeed by Mr. PROCTOR, on the ground that there must be such streams crowding richly together in the sun's neighborhood.

6. The view of the corona suggested by Sir WILLIAM SIEMENS in his solar theory.

(To be Continued.)

THE ANNULAR ECLIPSE.

BY CHARLES H. ROCKWELL.

I have seen several notices of observations made at the time of the recent annular eclipse—March 16; but no one seems to have been on the path of the annulus, or even near it. In this respect I was more fortunate than they.

The central line when plotted on a map, struck the coast of California a little south of the mouth of Eel river: running thence north-easterly to the north-east corner of the state: and so on through the centre of Idaho and Montana to the Canadian boundary at 106° long. west from Greenwich. I left home with the intention to see this eclipse from the most favorable location. The difficulty, however, of locating with even tolerable accuracy the geographical position of the towns and rivers, deterred me from taking along any instruments whatever, although I had prepared for transportation a telescope of $2\frac{1}{2}$ inches aperture with equatorial mounting, solar prism, &c. I took therefore an ordinary wedge of colored glass, only. From the best information which I could obtain before leaving New

York, the most promising place seemed to be at or near Delta, the present terminus of the railroad leading towards Oregon. Assuming Lat. 41° 02′, Long. 122° 20′, I obtained as the circumstances of the eclipse local astronomical time March 15th, $19^h\ 43^m\ 57^s$, $20^h\ 59^m\ 23^s$, $21^h\ 01^m\ 22^s$, $22^h\ 25^m\ 21^s$.

On arriving in San Francisco I soon found that Delta presented more points in its favor than any other locality. By the courtesy of the Central Pacific Railroad I was given the aid and companionship of Mr. W. A. PALMER, Assistant Engineer of the railroad company. Also by the courtesy of the railroad officials, the train was run from Redding to Delta to suit our convenience, so that we arrived at our destination soon after 8 o'clock on the morning of March 15th. This enabled us to receive the noon signals from the Observatory at Washington, which came to us at 9 A. M. 120th meridian time. As it was Sunday, the telegraph line was almost free from local business, and the signals came through *perfectly*. I think I can say we received every beat of the clock at Washington without any break or uncertainty. On Monday the signals were quite unsatisfactory, and it was no easy matter to identify the beats which came through. On the 16th, the atmospheric conditions were all as favorable as anyone could desire. The instrument which Mr. PALMER had brought was an engineer's field transit of the ordinary construction. This required a constant manipulation of the altitude and azimuth screws, in order to keep the *Sun* in the field. Owing in part to this disadvantage, we lost the first contact, as the *Moon* had been on the *Sun's* disc 8 or 10 seconds before it was noted.

I consider the other phases as wholly reliable, viz:

1st contact—Lost.		
2d	"	$9^h\ 07^m\ 09^s$.
3d	"	$9^h\ 09^m\ 06^s$.
4th	"	$10^h\ 32^m\ 43^s$.

Time, 120th meridian. Clock error, 01^m, 11^s, slow.

The difference in the apparent diameter of the *Sun* and *Moon* was 1′ of arc, as nearly as may be. This would leave 30″ of the *Sun's* disc exposed when the annulus was perfect. In the opinion of Mr. PALMER, as seen through his instrument, the

width of the rim of light was the same on the upper and lower side of the *Moon*. It certainly seemed so to me, as seen through the glass wedge, and a half dozen by-standers using smoked glass agreed as to the uniformity of the two strips of suulight. I conclude therefore we were almost exactly on the central line. The light was so intense that at no time could one look at it with the eye unprotected. I had prepared a lantern to be used if necessary, but I had no difficulty in picking up the time on my watch, a sweep second on a white dial. In some newspaper articles before the eclipse I had seen a discussion as to the possibility of seeing the corona on this occasion. Having distinctly in mind the first appearace of the coronal light as seen in Colorado, July 28, 1878, and again on Caroline Island, May 6, 1883, I did not consider it possible that this phenomenon should present itself, unless the *Sun's* light was wholly obscured, I saw nothing of any indications of the corona as seen at the time of the two eclipses before mentioned. If any of this delicate silvery effect was present, it was wholly absorbed in the shade glasses which it was necessary to use, to look even in the direction of the point of interest in the heavens. We did see, however, a magnificent diffraction halo of some 4° diameter, surrounding the *Sun*, caused doubtless by the *Sun's* rays going obliquely over the disc of the *Moon*. As a matter of scientific importance, I do not attach any value to these notes, but as a magnificent astronomic spectacle, it was eminently well worth seeing. I give below the position of Delta as derived from the U. S. Land Surveys:

Latitude 40° 56′ 16″7,
Longitude 122° 24′ 58″3.

It is doubtless more nearly correct than the position which I assumed, but I should not be willing to accept it as correct to the tenth of a second.—*Argus.*

Tarrytown, N. Y., May, 1885.

No. 2661 *Astronomische Nachrichten* contains a list of 100 new nebulæ discovered at the Marseilles Observatory, France, by M. STEPHAN. The description, right asscension and declination of each are given for 1885.0.

THE CONSTELLATIONS.

THE EDITOR.

A few years ago a book was published in England by FRANCES ROLLESTON, of Keswick, entitled "*Mazzaroth, or The Constellations.*" Soon after a second edition appeared and the work received some attention, and favorable comment in both England and America, although its circulation has been surprisingly small in this country. On this account we venture to call attention again to some of its leading points on topics of general interest to Astronomy.

Most persons know something about the names, and figures that astronomers call the constellations of the Zodiac. When these figures are drawn prominently and in full in the celestial maps or globe, the meaning which they convey, concerning the early history of astronomy is indifferent to many, unattractive to some, and repulsive to others.

So distasteful have they become to the modern astronomer that he has quite abandoned their use as a means of reference in ordinary work, partly, perhaps, on account of the unscientific spirit they seem to foster, and partly, because of late improved methods of reference. This is natural, and, as might be expected, in view of the changed forms and meanings of the figures, representing the constellations since very early times, the introduction of others, incongrnous and absurd, and the evident corruption of names that have suffered in the hands of the heathen mythologist.

The object of the book above referred to is a most laudable one. It is to show by traditions, ancient writers, and the meaning of the ancient names of stars, still extant, that such symbols were chosen to convey the earliest and most important knowledge possessed by the first fathers of mankind. It endeavors to prove that for higher and more important records,

those of the only true wisdom of man are contained in the emblems of the constellations. The agreement of the figures with the types used by the prophets of the Bible since the world began, is a strange coincidence, and the fact that in the names the very words in which the prophecies were delivered are frequently to be recognized, is still more strangely suggestive, when it is understood that the primitive roots by which the Assyrian and Babylonish records are now interpreted "exist alike in the names of the stars and the dialects used by the prophets."

We are aware that these names and the ideas conveyed by the figures are found in the mythology of nations, and we know that strange and degrading uses were made of them in heathen imagery, but it now more clearly appears, chiefly by late eminent linguistic research, that their fables were drawn from the constellations, and not the constellations from the fables. If this be true, and it can be shown that the wisdom of the Creator was peculiarly manifested thus, in the beginnings of the history of our noble science, it will certainly give new interest to the student of science in early records and general antiquarian research. There are many questions in astronomy to which no certain answer has been given. Pertaining to its early history such as the following are examples: With whom did astronomy begin? When and where? By whom were the earliest extant emblems and names of the stars chosen? What is their meaning and why were they chosen? Why were these constellations allotted three to each sign? Why were they so figured and thirty-six of them so related?

The discussion of these and other kindred topics is presented in FRANCES ROLLESTON'S book more clearly and definitely than elsewhere known to the writer. So far as known no answer to this book has been attempted.

There are many occultations of stars by the *Moon* during July, but nearly all are of small magnitude.

Observations of the "Pons-Brooks" Comet, 1883 and 1884, made with the filar micrometer on the 6.4 inch Equatorial of the Davidson Observatory, San Francisco, Cal., Long. 8h. 09m. 42.6s W. of Gr.

Date. 1883.	Observer.	Local Mean Time	Star—Comet Observed difference uncorrected. Star. Δα	Comet. Δ N. P. D.	Comparisons.	Comparison Star. Letter.	Estimated mag.	Name, if Identified.
		h. m. s.	m. s.	′ ″				
Dec. 12	D	8 29 42½	−0 45.47	−0 21.5	3	a	8½	Radcliffe 4380.
14	D	8 15 48	— 04.66	+0 04.4	7	b	10½	A. pl. 40°: 3888, 9.1.
		8 37 30	— 10.32	−0 28.2	11	b	10½	do
		8 51 26	— 13.86	−0 46.1	5	b	10½	do
16	D	7 59 46	— 36.60	−3 09.5	12	c	—	Anon.
		8 21 30	+ 08.61	−0 44.8	11	d	—	Anon.
18	D	8 25 16	— 39.16	+2 18.4	5	e	11	A. plus 38°: 3954, 9.0.
		8 35 16¼	−0 42.04	+1 59.5	5	e	11	do
20	H	7 36 49	−1 24.18	−3 44.3	6	f	—	A. plus 36°: 4065, 8.6.
22	D	7 57 38	+0 04.20	±0 00.0	1	g	10	A. plus 34°: 4117, 8.9.
		8 06 17	+ 11.53	+0 18.5	9	h	10½	A. plus 34°: 4119, 9.5.
		8 24 12	— 03.90	−1 05.3	9	g	10	A. plus 34°: 4117, 8.9.
26	D	8 06 19½	— 42.77	−4 00.0	6	i	10	A. plus 30°: 4335, 9.4.
		8 18 00½	−0 46.37	−4 34.1	6	i	10	do
27	H	7 10 56	−2 21.60	−7 44.4	18-6	j	6-7	Yarnall 9281.
	H	7 35 15	−0 08.48	−0 09.6	6	k	—	A. plus 29°: 4362, 9.3.
	D	8 03 08½	−0 16.60	−1 21.1	14	k	—	do
28	H	6 26 10	−2 01.78	−2 58.7	18-6	l	8-9	A. plus 27°: 4049, 8.2.
29	D	7 57 03	−0 14.46	−0 58.7	5	m	9	A. plus 26°: 4186, 9.4.
		8 01 26½	— 16.15	−1 14.2	4	m	9	do
		8 30 50	— 38.00	−1 20.7	6	n	9	A. plus 26°: 4184, 9.4.
		8 43 29	−0 41.72	−1 07.0	4	n	9	do
1884.								
Jan. 3	D	8 08 30	+0 16.02	−1 05.9	5	o	10	Arg. plus 18°: 4394.
		8 13 00	14.44	−1 24.5	5	o	10	do
		8 17 23½	13.46	−1 42.8	5	o	10	do
9	H	7 07 21½	09.08	−1 14.2	5	p	8½	A. plus 7°: 4932.
	H	7 12 04½	08.68	−1 37.0	4	p		do
	D	7 23 26	05.70	−2 32.2	4	p		do
	D	7 28 18	04.27	−2 55.1	7	p		do
	D	7 33 24	+0 02.93	−3 19.4	7	p		do
10	D	8 15 38½	−1 14.30	−1 17.9	4	q	—	A. plus 5°: 5104.
		8 26 21	−1 16.76	+0 27.8	5	q		do
11	D	8 01 58½	−0 22.20	−2 43.4	4	r	—	A. plus 3°: 4812.
24	D	6 20 47	−1 46.71	−0 16.4	21-7	s		Wash. M. C. Zones 206, No. 36.
	D	6 36 02½	−1 49.43	−1 11.4	6-2	s		No. 36.
	D	6 36 02½	−1 25.45	−2 20.9	6-2	t		No. 39.
	H	6 47 45½	−1 51.37	−1 54.9	6-2	s		No. 36.
	H	6 47 45½	+1 23.36	−3 05.0	6-2	t		No. 39.
25	D	6 49 59½	+2 56.07	+1 08.6	15-5	u	7	Wash. M. T. Zones 198. No. 34.

NOTES TO COMPARISON STARS.

(j.) Pos. 1883.0: α=21h. 09m. 10.22s.; N. P. D.=60° 34′ 56.8″ from A. N. No. 2591.

(l.) Pos. 1883.0: α=21h. 16m. 29.78s.; N. P. D.=61° 55′ 44.5″ from A. N. No. 2572.

(p.) Pos. 1884.0: α=22h. 43m. 07.57s.; N. P.D.=82° 04′ 10.0″ from Grant 1870.

(s.) Pos. 1884.0: α=0h. 02m. 37.97s.; N. P. D.=108° 13′ 16.5″ from A. N. No. 2591.

The * is Lalande No. 47332.

(u.) The * is Lalande No. 257.

Observer: D—George Davidson. H=Chas. B. Hill.

EDITORIAL NOTES.

Continued and unexpected absence from home was the reason for not publishing the MESSENGER for June as usual. It will hereafter appear regularly for each month, during the remainder of the year. A recent change in printers gives the MESSENGER a new dress which speaks plainly for itself. When the Greek fonts and desirable astronomical symbols are secured, our pages will appear beautifully complete through the earnest efforts of a skillful man in charge of the printer's cases.

Volume one of the MESSENGER is out of print. Volumes two and three can be furnished in numbers at the usual price, in plain library binding at $3.00 each. The small sum of $250 would enable the publisher to reprint the exhausted numbers of volume one. Here is an opportunity for some generous friend to assist in a worthy cause. We are unable to fill a number of foreign orders for full sets of this publication which have been recently received.

Professor A. HALL, Naval Observatory, Washington, D. C., in a recent letter, speaks of the spring and summer of this year, as the most unfavorable for observation during the past eleven years. Latterly he has been busy in getting his observations of the satellites of *Uranus* and *Neptune* ready for printing. The reductions for the satellites of *Uranus* are already finished. From all the observations on the two outer satellites, *Oberon* and *Titania*, he finds the mass of

$$Uranus = \frac{1}{22682 \pm 27}$$

This is a slight dimunition of the received value. The oppositions of *Uranus* which Professor HALL observed, from 1881 to 1884, were very well suited to fix accurately the position of the orbit plane of the satellites, because the *Earth* passed through this plane in 1882, and probably the node and inclination are well determined by these observations.

COMET-METEOR RADIANTS.

Below will be found a list of Comet-Meteor Radiants and Distances which I have calculated from the orbit elements of recent comets.

The present list includes the radiants of all the principal comets that have appeared since the first of 1880. The only ones omitted are some three or four faint ones of short period which have already been included in previous lists.

The first column contains the current number; the second gives the designation of the comet by the recent method in the order of perihelion passage of the year; the third, the discoverer; the fourth, the day of the *Earth's* passage through plane of comets' orbit; the fifth designates the nearest node; the sixth, the distance of this node from the *Earth's* orbit in the order R—r, the *Earth's* distance from the *Sun* being taken as unity; the seventh and last column gives the radiant point for the given date.

If, as is generally accepted, comets are formed of meteors, or, at least, have meteors traveling in the same orbits with them, we may be able to identify some past or future showers with some of the comets of the last few years, which has been a period of so much cometary activity.

Allowing for the lateral spreading of meteors in their orbits, we see there are several comets whose meteors we should be liable to encounter, the most noteworthy case being that of Comet 1882.I, where the distance from the *Earth* at node is less than three million miles.

Current Number	Designation of Comet.	Discoverer.	Day of Earth's passage through line of Nodes.	Designation of Node.	Earth's distance from Node.	Comet-Meteor. R. A.	Radiant. Dec.
1.	1880. I.	Gould.	Mar. 16.	Descending.	+0.98	298.1	— 6.2
2.	1880. II.	Schæberle.	Dec. 9.	Descending.	—1.02	194.6	+28.9
3.	1880. III.	Hartwig.	Nov. 7.	Ascending.	+0.60	142.0	— 8.0
4.	1880. IV.	Swift.	Jan. 17.	Descending.	—0.68	305.6	—12.2
5.	1880. V.	Pechule.	May 31.	Ascending.	+0.33	44.7	—74.6
6.	1881. II.	Swift.	July 30.	Descending.	+0.43	347.3	+69.7
7.	1881. III.	Tebbutt.	June 22.	Ascending.	+0.28	56.4	—58.8
8.	1881. IV.	Schæberle.	June 28.	Descending.	+0.20	14.7	+29.7
9.	1881. V.	Denning.	Nov. 28.	Ascending.	+0.12	274.1	—36.1
10.	1881. VI.	Barnard.	June 26.	Asc nding.	+0.57	19.9	—34.8
11.	1881. VIII	Swift.	Sept. 24.	Descending.	—1.66	116.9	+39.9
12.	1882. I.	Wells.	April 15.	Ascending.	+0.03	356.9	—14.4
13.	1882. II.	Gould.	Marh 16.	Descending.	+0 97	200.9	— 8.1
14.	1882. III.	Barnard.	Dec. 1.	Descending.	—0.51	137.8	+56.9
15.	1883. I.	Brooks.	Dec. 30.	Descending.	—0.14	244.0	+25.6
16.	1883. II.	Ross.	Dec. 16.	Descending.	+0.63	175.8	+42.0
17.	1884. I.	Pons-Brooks	Dec. 6.	Descending.	+0.18	198.9	+67.9
18.	1884. II.	Barnard.	Sept. 28.	Ascending.	—0.69	198.5	—17.2
19.	1884.	Wolf.	Oct. 20.	Descending.	—0.58	275.2	+39.7

Harvard College Observatory, 1885, June 26. O. C. WENDELL.

We greatly regret to record the death, on May 19, of the Rev. T. W. Webb, M. A., in the 79th year of his age. Mr. Webb was a Prebendary of Hereford Cathedral, and Vicar of Hardwick, Herefordshire. He frequently contributed, chiefly on astronomical subjects, to "*Nature*," "*The Astronomical Register*," "*The Intellectual Observer*," "*The Student*," etc., but his principal contribution to astronomical literature was the widely known and highly valued, "Celestial Objects for Common Telescopes," a work by which he will long be rememdered. — *Observatory.*

DARK TRANSIT OF JUPITER'S IV SATELLITE.

The greater portion of this transit was observed here, both with the 10-inch reflector and three-inch Tulley refractor. Definition fair; temperature 54 F.; barometer 30.14.

The satellite for the greater part of the transit appeared black, as it commonly does; but what I should like to call attention to is, that this blackness remained until egress, *instead of disappearing about ten minutes before*—an observation I believe unique, and seen also by Mr. GLEDHILL of Bermerside, as well as others.

Further than his nothing unusual occurred, excepting that for about half an hour, between 11 and 11.30, the satellite became exceedingly faint, appearing to me, at times of good definition, irregularly elongated parallel to the belts, assuming then more of a chocolate color. (Mr. GLEDHILL also noticed the faintness and ill-defined appearance at the same hour.) I was also struck by the faint appearance both before and after transit of this satellite as compared with the others; and, to use an expression once employed by DAWES, "it was far from obvious."

I may add that Satellite III, during a dark transit on May 2 (temperature 46° F., barometer 29.58, definition good until the time of egress, when it became unsteady) was quite different. While dark, it appeared uniformly round, and of a deep steel color, and about ten minutes before egress became invisible, but eventually reappeared on the limb of the planet, perfectly white and defined, during good moments of definition.—*Monthly Notices.*

In a late issue of the "*Evening Bulletin*", Philadelphia, an editorial article appears of some interest, pertaining to the nebulæ. Its concluding paragraph is as follows:—

"It is remarkable that the nebulæ have only lately become known. HALLEY, a great English astronomer, is 1714 published a list of 6. HEVELIUS soon enlarged it to 16. LACAILLE, in 1755, by observations at the Cape of Good Hope, increased the catalogue to 64. MESSIER, in 1784, further enlarged the number to 103. Sir WILLIAM HERSCHEL then took up the subject in real earnest, and in 1802 he published a catalogue of 2,500. A similar number was added by his son, chiefly at the Cape of Good Hope. Other laborers have entered the field, and now about 7,000 nebulæ are known. For many years past the work in nebular astronomy has been nearly stopped. But less than two years ago it was taken up anew by Professor LEWIS SWIFT, of the Warner Observatory, at Rochester, N. Y., and already he has discovered two hundred new ones. He is one of the very best observers in our own day, and it is to be hoped he will persevere in this great undertaking. He has given to the world a a very important paper on the Nebulæ in the January and March numbers of the *Sidereal Messenger*, a monthly magazine on astronomy, published at Northfield, Minn., to which we would refer our readers."

Under date of January, 23rd, 1885, Dr. DOBERCK, the Government Astronomer at Hong Kong, China, published a circular containing twenty-

two right ascensisns of the moon observed at Hong Kong, from November 25th, 1884, to January 4th, 1885. The instrument employed was the Troughton and Simm's transit of three inches aperture. The observations were compared with the tabular places of the Nautical Almanac (which contain Newcomb's corrections.) The resulting correction being, in the mean +0s.073. From these observations Dr. Doberck deduces a correction to Hamen's semi-diameter of −0s.127. Applying this correction to his observations, the resulting mean correction to the Nautical Almanac is +0s.091. J. T., Jr.

The Observatory at Warschan has just been supplied with a meridian circle of 162 millimeters aperture and 2.27 meters focal length, by Ertel of Munich. The circles are 790 millimeters in diameter. One is capable of being turned upon the axis, and is divided to 3′. The other is intended only for setting purposes and is divided to 10′. On both circles every degee is numbered. There are four microscopes on each side. The microscope bearers are of the same design as those upon the old Repsold circles and are supplied in the some way with spirit levels. The illumination of the field is effected by means of prisms within the cube, the light coming from lamps attached to the outside of the piers. For illuminating the circle a prism is attached to the end of the microscope nearest the circle. J. T., Jr.

In late numbers of the *Observatory* W. F. Denning has been discussing the comparative merits of reflecting and refracting telescopes. In the course of the discussion he says:

"If Professor Young finds it feasible to examine critically the faint details of *Jupiter* with powers of 950 and 1200, his telescope must be a very remarkable one. Certainly no small instrument can boast a record anything like this. *Jupiter* is rather a test of definition, and I had no idea there was any telescope in existence that would give us a sharp disc and a steady view of the more delicate features with a power of 600, or only half that mentioned by Professor Young. When, however, your able correspondent states that he has successfully employed 1200 to settle critical matters of detail on the planet, I have only to confess that the Princeton refractor has effected a very fine performance, and one that speaks volumes for its defining capacity, and for the favorable site of the observatory, as regards meteorological conditions. Professor Young's experience with a large telescope is of so exceptional a character that any further information he may afford us will be of deep interest. It now remains for the Princeton refractor to further exhibit its powers by grasping new features of planetary phenomena, for after all we must look to original results as the most safe and enduring proofs of real capacitp."

The Messenger would like to know the American meaning of the

above English paragraph. We would suggest to Professor YOUNG that he try the defining power of the Princeton equatorial on it in Princeton air. If he be not sure of the details of the compliment by observing in the ordinary way, try a look at it backwards through tho object-glass, and see if the small image will not be more steady, when reduced in such an original way.

By kindness of E. W. MAUNDER, Editor of the *Observatory* (English) we have a copy of his recent paper, "*The motions of stars in the line of sight*," published in parts in late numbers of the *Observatory*. It contains a careful and somewhat full statement of the way in which the motions of the heavenly bodies, in the direction of the visual ray, are studied, the power needed, the practical difficulties in the way of successfully manipulating the spectroscope, and some of the results reached in work at the Royal Observatory recently.

The observations of the star *Sirius* have brought out some singular and unexpected results. In 1868, Dr. HUGGINS found the star to be receding from us at the rate of 29 miles per second. From observations by Mr. MAUNDER during last winter the star appears to be approaching us at a rate of 22 miles per second. Since observations between these dates show a gradual change of motion it has been suggested that the star may be moving in an eliptical orbit, which would fairly accord with the snpposition of Dr. PETERS and others who have claimed that *Sirius* has motion in right ascension and declination at right angles to the line of sight. This paper does not claim to make any comparison between these two kinds of observation, but simply mentions these coincidences as worthy of notice. The difficulty and nicety of this work is better understood by the unexperienced when it is said that the *F* line in the spectrum of *Sirius* changed in position a little more than one twentieth of its total breadth in a period of nine years preceding 1884. That would make the annual change of the line in position less than one hundreth of its breadth. The paper is an instructive one.

Those who read the article in our last issue, entitled "*Recently Discovered Asteroids*," by Professor DANIEL KIRKWOOD, will remember that No. 244 was then the last new minor planet with known elements. Since, the elements of Nos. 245, 246 and 247 have been determined with mean distances respectively 3.0778, 2.7208, and 2.7423. It is interesting to notice that none of these new planets fall in the gapes, which, some time ago, were pointed out in the great asteroid belt by Professor KIRKWOOD and others. We have not yet seen the elements of the new asteroid No. 248.

ERRATUM.—On page 115 (May number) the last word "equator" should be "ecliptic."

A black transit of *Jupiter's* III Satellite was witnessed here on the night of May 9th, at 7*h*. 15*m*. Nashville mean time. The Satellite was seen as a small, round, black spot on the edge of the northern equatorial band. It remained extremely black and well defined—when the unsteady air allowed a fair view—until near the preceding limb. The Satellite passed the center of its apparent path of 8*h*. 0*m*. At 9*h*. 9*m*. III had lost some of its blackness. At 9*h*. 26*m*. still dark, not easy to see; 9*h*. 13*m*. very dim and close to limb; 9*h*. 38*m*. III totally invisible; 9*h*. 40*m*. it was faintly visible and white just on inside of the limb—first contact at emergence. At 9*h*. 43*m*. it was about one-half off disc and as white as any part of *Jupiter's* disc; 9*h*. 55*m*. III was some distance from the limb, not as large or as bright as I (near it preceding). The contact of center of III with *Jupiter's* limb was at 9*h*. 44*m*. Observations were made with the six inch telescope, power 120.

E. E. BARNARD.

Vanderbilt University Observatory, Nashville, May 1885.

FACE OF THE SKY.

The evening sky for July will be attractive to the ordinary observer. At ten o'clock, during the first part of the month, *Scorpio* is seen passing the meridian low in the south for latitude 45°. It will be readily recognized by the bright, red star, *Antares*, and the fan-like appearance of the large, loose group of stars to the west and north of it, which constitutes the principal part of the constellation. The handle of the fan, so to speak, points obliquely downward toward the horizon, makes a sudden turn upwards and terminates in two stars, which are easily seen a little way above the horizon. *Antares*, the leading star in the constellation, is a beautiful sight in the telescope. It is fiery red with flashes of crimson and feebler tints of green. This varying color may be due to a seventh magnitude star quite near it, which is green, and independently so, for it has been seen separately when *Antares* was occulted by the *Moon*. About 3½° to the north, and 3° to the west of *Antares* is a brilliant field in the small telescope, in the midst of which is a rich and condensed star-cluster, one of the finest in the northern sky. There are two other clusters near at hand.

To the north of *Antares* forty-five degrees, and to the west thirty, is the bright star *Acturus* in the constellation *Bootes*. Astronomers are not agreed which star ranks in brightness, this or *Vega*, which is also seen about as far on the east side of the meridian as that is on the west. *Acturus* is a star of great interest because of a large annual motion of its own among the neighboring stars; yet it is so far away that it has no sensible parallax, and it is only a rough guess that says its light is any

certain number of years in reaching the *Earth*. But this we do know, that since the time of HIPPARCHUS, *Arcturus* has changed its place in the sky 2½ times the diameter of the *Moon*. Such a change of place is called proper motion, and is surprisingly great in the case of this star. *Bootes* is rich in double stars, but poor in clusters and nebulæ.

The remaining bright star in the west, which is very near the western horizon is *Jupiter*. He is now so far away, and so unfavorably seen, that telescopic study is given up for a while.

The other star referred to above is the leader of *Lyra*. When *Vega* passes the meridian on clear nights, in this latitude, the telescope does not reveal a richer sight its color being a pale sapphire. By photometric measure, some time ago, at Harvard College observatory, its light was found to be seven times that of *Arcturus*, which seems large, and may possibly be due to its peculiar hue. Its parallax is almost a half second of arc, determined by late studies of Professer A. HALL, of Washington, and therefore its light is almost seven Julian years in coming to our eyes from its distant star-path.

Near *Vega*, about two degrees east and nearly one north, the naked eye observes an interesting star, wnich is seen to double by the aid of the smallest telescope. This is the noted pair often spoken of in elementary text-books, as *Epsilon* one and two. Increase of optical power shows that each component is double, forming a binary system of its own, the first pair revolving in possibly two thousand years, the second in one thousand years, and both systems rotating about a common center of gravity in probably something less than one million of years. The colors of the components of one pair are yellow and ruddy, of the other, both are white. A strange feature of this quadruple group is the excessively faint stars between the double-double, which are sometimes called the debillissima The number of mere points of light is uncercertain.

We can only mention the annular nebula of this constellation, which lies one third of the way between *Beta* and *Gamma*, and is easily found by common telescopes. Though not brilliant it is a most interesting phenomenon under high power.

To the north and a little to the west of the zenith is the constellation of *Ursa Major*, while in the north-east, near the horizon is seen *Cassiopeia*, both of which were spoken of recently. Nearly all the planets are now so unfavorably situated for evening study that we omit special notice of them until later.

The following orders and subscriptions have not been previously acknowledged:

Professor J. S. McGhee. Cape Girardeau, Mo. Professor C. Piazzi Smyth, Royal Observatory of Scotland, Edinburg, Scotland (2 vols.) Willis L. Barnes, Charleston, Clark Co. Indiana. Prof. C. W. McLeod, McGill College, Montreal, Ca.

BOOK NOTICES.

Elements of The Calculus, by J. M. TAYLOR, Professor of Mathematics, Madison University. 252 pp. Mailing price, $1.95. Boston, Messrs. GINN, HEATH & COMPANY, Publishers.

This book starts with the theory of limits as a means of explaining the elements of the calculus. The method of rates, so called, is used to illustrate finite differentials, or increments from which, by the aid of geometrical figures, common to best works, the author passes to the ordinary notation, $\frac{dy}{dx}$

These steps are taken with care and clearness, especially to the minds of those who explain the fundamental principles of the science in this way. While this means of developing the elements has the disadvantage of length. and some difficulty to the untrained mind, it has the advantage of avoiding the indeterminate form of $\frac{0}{0}$

and, easily glides into the uses of the infinitesimal notation.

It is also an advantage to have, as often as practicable, chapters on Integration follow immediately after those on Differentation on the same subjects. There is gain to teacher and pupil by this plan. The teacher of the Calculus will find this work one of the best in matter and arrangement. Its typographical dress is neat and tasteful as we always expect from Messrs. GWIN, HEATH & COMPANY.

The Sun and His Phenomena, by Rev. T. W. WEBB, with numerous illustrations, pp. 80. Neatly bound in cloth, 40 cts. Industrial Publication Company, 294, Broadway, New York.

Every person acquainted with late writers in England on popular astronomy knows something of the work of Rev. Mr. WEBB, entitled "Celestial Objects" by which he has earned wide and deserved fame. The little book whose title is given above is his latest and consists of a familiar description of the *Sun's* phenomena presented in Mr. WEBB's ewn pleasing and attractive style, It briefly notes the progress of solar studies to date and gives the most prominent facts with the care and accuracy of a practical astronomer.

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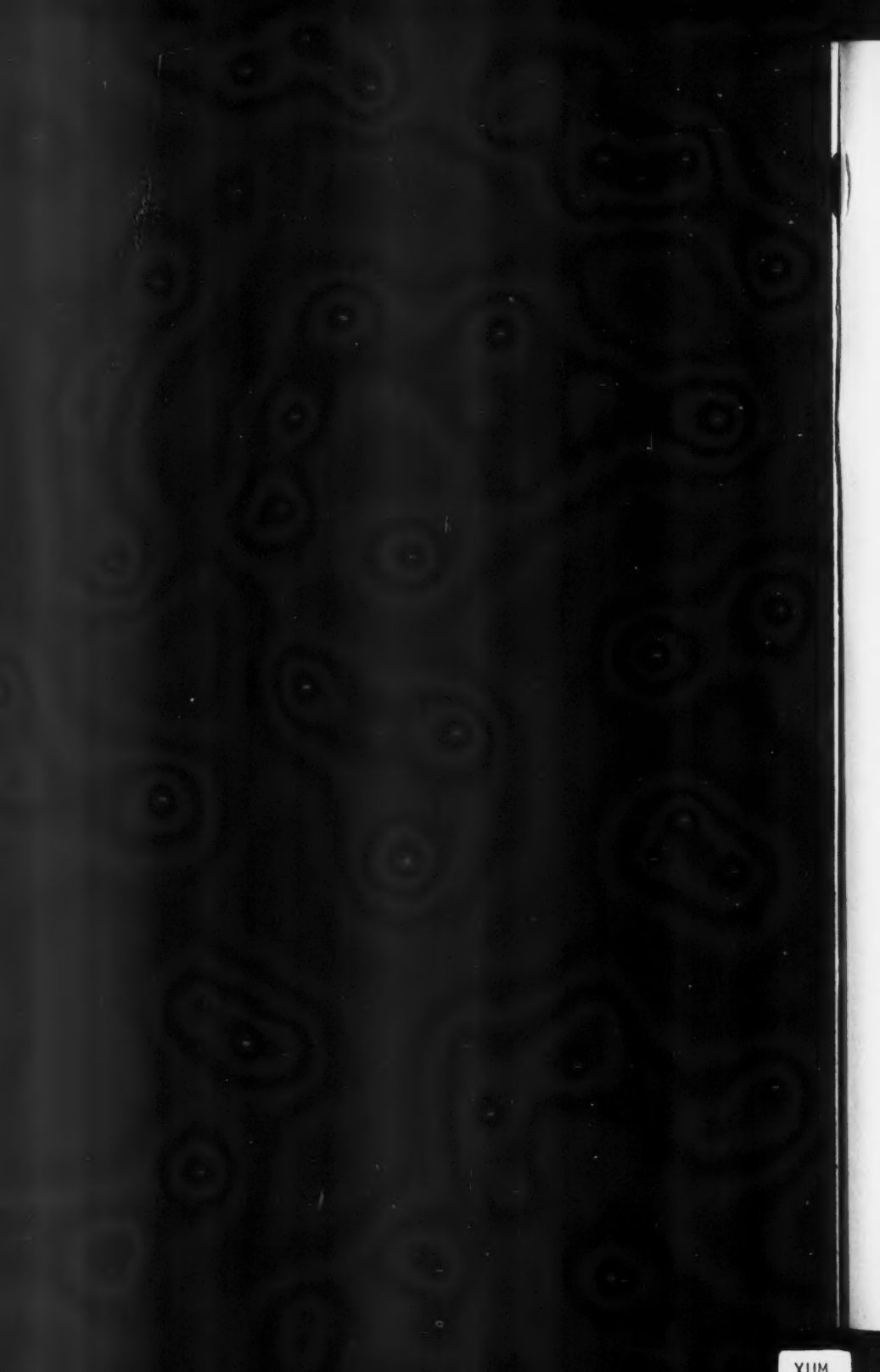

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CALENDAR.

Fall Term begins. Wednesday, September 9, 1885,
Term Examinations, December 21st and 22d, 1885.
Winter Term begins Wednesday, January 6, and ends March 18, 1886.
Term Examinations, March 17th and 18th, 1886.
Spring Term begins Wednesday, March 31, and ends June 17, 1886.
Examinations to enter College, June 12 and 14, and Sept. 7, 1886.
Term Examinations, June 15 and 16, 1386.
Anniversary Exercises, June 14–17, 1886.
Exihbition at Art Room of work of Pupils in Drawing and Painting, June 14–17, 1885.
Wednesday, September 8, 1886, Fall Term begins.

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